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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/849,348	05/19/2004	Robert H. Burgener II	3398.2.10	6690

21552 7590 05/24/2006

MADSON & AUSTIN  
GATEWAY TOWER WEST  
SUITE 900  
15 WEST SOUTH TEMPLE  
SALT LAKE CITY, UT 84101

EXAMINER

LOUIE, WAI SING

ART UNIT PAPER NUMBER

2814

DATE MAILED: 05/24/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

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<b>Office Action Summary</b>	<b>Application No.</b> 10/849,348	<b>Applicant(s)</b> BURGENER ET AL.	
	<b>Examiner</b> Wai-Sing Louie	<b>Art Unit</b> 2814	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

- 1) ☒ Responsive to communication(s) filed on 09 March 2006.
- 2a) ☒ This action is **FINAL**.                      2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

- 4) ☒ Claim(s) 1-8 and 11-44 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1-8 and 11-44 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

**Application Papers**

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

**Priority under 35 U.S.C. § 119**

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All    b) ☐ Some \* c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
  2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
  3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

**Attachment(s)**

- |  |   |
|--|---|
| 1) <input type="checkbox"/> Notice of References Cited (PTO-892)   | 4) <input type="checkbox"/> Interview Summary (PTO-413)<br>Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948)   | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152)             |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)<br>Paper No(s)/Mail Date <u>10/5/05</u> . | 6) <input type="checkbox"/> Other: _____  |

## DETAILED ACTION

### *Claim Rejections - 35 USC § 102*

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

Claims 1-8, 11-12, 14-16, 18-20, 22-28, 31-35, 37-39, and 42 are rejected under 35 U.S.C. 102(b) as being anticipated by White et al. (US 6,291,085).

With regard to claims 1, 23, and 42, White et al. disclose a ZnO light-emitting device (col. 3, line 63 to col. 9, line 7) comprising a pn junction containing a p-type ZnO semiconductor material and an n-type ZnO semiconductor material (col. 2, lines 20-30), where the p-type ZnO semiconductor comprises a single crystal thin film of a ZnO layer doped with p-type dopant (col. 2, line 32), where the p-type dopants selected from arsenic, antimony, bismuth, phosphorous, and copper (col. 4, lines 13-20), and concentration in p-type ZnO layer is greater than  $10^{16}$  atoms. $\text{cm}^{-3}$ , where the semiconductor resistivity is less than 0.5 ohmic-cm, and where the carrier mobility is greater 0.1  $\text{cm}^2/\text{V.s}$  (col. 2, lines 31-36), where the p-type ZnO layer has a luminescent peak at about 3.36 eV (col. 8, lines 49-60).

With regard to claim 2, White et al. disclose the Group II element is Zn (col. 2, line 21).

With regard to claim 3, White et al. disclose the Group IV element is oxygen (col. 2, line 21).

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With regard to claims 4 and 24, White et al. disclose the p-type dopant is phosphorus (col. 4, line 18-20 and fig. 2).

With regard to claim 11, the method of deposition is a process limitation, which does not carry any patentable weight in a device prosecution.

With regard to claim 12, White et al. disclose the Group II-VI semiconductor material is ZnO (col. 2, line 21).

With regard to claims 5-8 and 25-28, White et al. disclose the other p-type dopants include arsenic, antimony, bismuth, and copper (col. 4, lines 13-20).

With regard to claims 14-16 and 33-35, White et al. disclose the device could be a light-emitting diode, or a laser diode, or a field effect transistor (col. 1, lines 11-14).

With regard to claims 18-20 and 37-39, White et al. disclose the device emits light at a wavelength of about 370 nm (fig. 2).

With regard to claim 22, White et al. disclose the n-type semiconductor material is an n-type ZnO (col. 3, lines 10-25).

With regard to claims 31-32, White et al. disclose n-type semiconductor material is ZnO and the n-type dopant is aluminum (col. 7, lines 19-29).

### ***Claim Rejections - 35 USC § 103***

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person

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having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claims 21, and 40 are rejected under 35 U.S.C. 103(a) as being unpatentable over White et al. (US 6,291,085) in view of Haga (US 6,838,308).

With regard to claims 21, and 40, White et al. do not disclose the self-supporting substrate surface is amorphous. However, Haga discloses the ZnO layer is disposed on an amorphous substrate 110 (Haga col. 4, lines 52-54 and fig. 3). Haga teaches the ZnO having a wurtzite type a-axis orientation and it is important to form on an amorphous substrate (Haga col. 4, lines 45-51). Therefore, it would have been obvious to one of ordinary skill in the art to modify White's device with the teaching of Haga to provide a substrate with an amorphous surface in order to form an a-axis crystal structure.

Claims 13, 29-30, and 43-44 are rejected under 35 U.S.C. 103(a) as being unpatentable over White et al. (US 6,291,085) in view of Yoshii et al. (US 6,707,074).

With regard to claim 13, White et al. do not disclose the Group II-VI semiconductor material is ZnS. However, sulfur is a Group IV element, which combines with zinc to form zinc sulfide, such as disclosed in Yoshii et al. disclose (Yoshii col. 20, lines 31-33). Yoshii et al. teach that it is possible to use a mixed crystal material of semiconductor compound to improve the light-emitting characteristic of the device (Yoshii col. 20, lines 31-50). Therefore, it would have been obvious to one of ordinary skill in the art to modify White's device with the teaching of Yoshii et al. to use ZnS as semiconductor material so that the light-emitting characteristic could be improve.

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With regard to claims 29-30 and 43-44, White et al. modified by Yoshii et al. disclose the single crystal ZnO further comprises MgO and CdO (Yoshii col. 20, line 33).

Claims 17 and 36 are rejected under 35 U.S.C. 103(a) as being unpatentable over White et al. (US 6,291,085) in view of Merrin (US 3,864,725).

With regard to claims 17 and 36, White et al. disclose a device having a pn junction, but do not disclose the device is a photodiode. However, it is common in the art to form a pn junction type photodiode such as disclosed in Merrin (Merrin col. 5, line 57 to col. 6, line 3). Therefore, it would have been obvious to one of ordinary skill in the art to form a pn junction photodiode.

Claim 41 is rejected under 35 U.S.C. 103(a) as being unpatentable over White et al. (US 6,291,085) in view of Harder et al. (US 5,331,655).

With regard to claim 41, White et al. do not disclose a barrier layer disposed between the single crystal ZnO and the amorphous self-supporting substrate. However, Harder et al. disclose the active layer can be a single or multiple quantum well, which includes a barrier layer (Harder - see the abstract). Harder et al. teach the barrier layer reduces carrier leakage out of the active region (Harder - see the abstract). Hence, it would have been obvious at the time the invention was made to modify White's device with the teaching of Harder et al. to provide a quantum well structure with a barrier layer in order to reduce carrier leakage out of the active region.

***Response to Arguments***

Applicant's arguments filed 3/9/06 have been fully considered but they are not persuasive.

- Applicant argues that White et al. do not disclose how to make p-type ZnO that possesses any of the disclosed electronic characteristics. However, this is a device prosecution and the process of making does not carry any patentable weight.
- Applicant argues that White et al. do not disclose the p-type ZnO layer has a luminescent peak at about 3.36 eV. However, White et al. disclose the claimed limitations in col. 8, lines 49-60.
- Applicant argues that the present invention review the Zn-O-As ternary diagram, which may include ternary compounds such as  $\text{Zn}_4\text{O}_9\text{As}_2$ ,  $\text{Zn}_3\text{O}_8\text{As}_2$ ,  $\text{Zn}_3\text{O}_6\text{As}_2$ , and  $\text{ZnO}_4\text{As}_2$ . However, these compounds are not in claims.
- Applicant argues the high temperature annealing in White et al. tends to destroy any persistent p-type characteristics. However, the process of making is not in the scope of device prosecution.

***Conclusion***

**THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

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A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

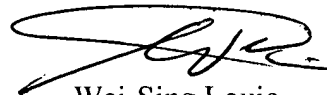
Any inquiry concerning this communication or earlier communications from the examiner should be directed to Wai-Sing Louie whose telephone number is (571) 272-1709. The examiner can normally be reached on 7:30 AM to 4:00 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Wael Fahmy can be reached on (571) 272-1705. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.



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Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).



Wai-Sing Louie  
Patent Examiner

Wsl  
May 21, 2006.